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terially enhanced. After what has gone before, we hardly need say, that the Hand-list is simply indispensable to the working ornithologist. — E. C.

ORIGIN OF LOWEST ORGANISMS.\*—The author's aim in this and other writings is to prove that while some monads (Bacteria) originate by subdivision of preëxisting individuals (homogenesis), others originate *de novo*, just as crystals originate by certain chemical laws. He thus goes still farther than those advocates of spontaneous generation who believe that Bacteria originate by the transformation of living matter (heterogenesis). For this new mode of spontaneous generation he proposes the term "Archebiosis."

We should premise that Bacteria are monads, the lowest and most minute organized beings, forming mere points of organized matter; they are highly refractive spherical bodies, and move with considerable activity. Torulæ are very similar bodies and are the germs of the yeast fungus. Professor Bastian has observed the ordinary reproduction by fission "most plainly when a few Bacteria have been enclosed in a single drop of fluid, pressed into a very thin stratum, in a 'live box' kept at a temperature of about 90° Fahr. by resting on one of Stricker's warm water chambers placed on the stage of the microscope. Under these conditions, I have seen a Bacterium of moderate size divide into two, and each of these into two others somewhat smaller, in the course of fifteen minutes." These monas-like bodies, as is well known, develop into higher organisms. "It is a fact, however, admitted by many, and which any patient microscopist is capable of verifying for himself, that some Bacteria do develop into Leptothrix filaments, and that these are capable of passing into a disseminated mycelial structure of larger size and undoubtedly fungus nature—from which, fructification of various kinds may be produced. Some Bacteria may therefore develop into some fungi, just as certainly as Torulæ may develop into some other fungi, or just as surely as some multiplying gonidia may develop into lichens. That some Bacteria are produced from preëxisting Bacteria, just as some Torulæ are derived from preëxisting Torulæ, may, it is

\*The Mode of Origin of Lowest Organisms: including a discussion of the experiments of M. Pasteur, and a reply to some statements by Professors Huxley and Tyndall. By H. Charlton Bastian, London and N. York. Macmillan & Co. 1871. 12mo. pp. 109, with two cuts. \$1.25.

true, be considered as settled." "But" he adds "so far as we have yet considered the subject, there may be just as good evidence to show that Bacteria and Torulæ are capable of arising *de novo*, as there is that some of them are capable of developing into fungi."

He next discusses the heterogenetic origin of Bacteria and Torulæ :—

"It has long been known that Bacteria and Torulæ are frequently to be found within vegetable cells, taken even from the central parts of plants whenever these are in a sickly condition or are actually dying. They are apt to exist also within epithelial cells taken from the inside of the mouth; and the frequency and abundance with which such organisms are met with in these cells, is almost in direct proportion to the malnutrition and lack of vital power in the individual who is the subject of observation. Then again, in persons who have died of adynamic diseases, in the course of twenty-four or thirty-six hours (during warm weather), Bacteria may be found in abundance within the blood vessels of the brain and of other parts, although no such Bacteria were recognizable in the blood of the individual during life.

In such cases we must in order to account for the presence of the Bacteria and Torulæ, either suppose that such organisms, in an embryonic state are almost universally disseminated throughout the various textures of higher organisms, both animal and vegetal (though they are only able to develop and manifest themselves when the higher organisms, or the parts of them in which the Bacteria or Torulæ are met with, are on the eve of death), or else we must imagine that when the vital activity of any organism, whether simple or complex, is on the wane, its constituent particles (being still portions of living matter) are capable of individualizing themselves, and of growing into the low organism in question. Just as the life of one of the cells of a higher organism may continue for some time after the death of the organism itself, so, in accordance with this latter view, may one of the particles of such a cell be supposed to continue to live after even cell-life is impossible."

This latter theory (heterogenesis) he favors as in part accounting for the production of Bacteria, as "evidence of a tolerably satisfactory nature, however, is forthcoming which may speak independently in favor of the doctrine of heterogenesis."

"It has been affirmed by Crivelli and Maggi that they have actually seen the particles within granular epithelial cells (taken from the back of the tongue of a patient suffering from diabetes) grow and elongate, so as to give rise to Bacteria, or fuse in longitudinal series so as to form a Vibrio. And, moreover, as I have

myself ascertained, if one takes healthy-looking epithelial scales scraped from the inside of the mouth, which appear to contain nothing but the finest granules, and places them with a little saliva in a 'live box' (and this within a damp chamber kept at a temperature of about 90° Fahr.), in the course of from five to ten hours, the cells may be found to be studded throughout with motionless Bacteria."

The origin, in the third place, of Bacteria and Torulæ by Archebiosis is supported by evidence, in the author's opinion, sharply defined and conclusive.

"Simple experiments can be had recourse to, which are not admissible in the discussion of the question as to the origin of Bacteria and Torulæ by Heterogenesis. Thus, we wish to establish the fact that living matter is capable of undergoing a certain metamorphosis, and consequently, we must deal with living matter. Here, however, with the view of establishing the fact that living matter can arise *de novo*, if we are able, shortly after beginning our experiment, to arrive at a reasonable and well based assurance that no living thing exists in the hermetically sealed experimental vessel—if the measures that we have adopted fully entitle us to believe that all living things which may have preëxisted therein have been killed—we may feel pretty sure that any living organisms which are subsequently found, when the vessel is broken, must have originated from some re-arrangements which had taken place amongst the not-living constituents of the experimental solutions, whereby life-initiating combinations had been formed."

The possibility of this mode of spontaneous generation is "intimately associated with the doctrine as to the cause of fermentation and putrefaction. Bastian espouses Liebig's theory of the cause of fermentation, *i. e.*, by sets of chemical changes, against Pasteur's, who believes that fermentative changes are begun by the influence of living organisms.

He also attacks the theory that the atmosphere is laden with the germs of Bacteria and Torulæ, and thinks that if they do have germs, they must be microscopically invisible to us. He then gives the results of a series of experiments which "seem to show quite conclusively that M. Pasteur's explanations are altogether inadequate to account for the occasional preservation of boiled fluids in bent-neck flasks." They lend no countenance, moreover, to his particular theory, that fermentation cannot be initiated without the agency of living ferments,—they are, on the contrary, wholly opposed to this restriction. In conclusion our author remarks:—

“It would thus appear that specks of living matter may be born in suitable fluids, just as specks of crystalline matter may arise in other fluids. Both processes are really alike inexplicable—both products are similarly the result of the operation of inscrutable natural laws, and what seem to be inherent molecular affinities. The properties of living matter, just as much as the properties of crystalline matter, are dependent upon the number, kind, and mode of collocation of the atoms and molecules entering into its composition. There is no more reason for a belief in the existence of a special “vital force,” than there is for a similar belief in the existence of a special “crystalline force.” The ultimate elements of living matter are in all probability highly complex, whilst those of crystalline matter are comparatively simple. Living matter develops into Organisms of different kinds, whilst crystalline matter grows into Crystals of diverse shapes. The greater modifiability of living matter, and the reproductive property by which it is essentially distinguished from crystalline matter, seem both alike referable to the great molecular complexity and mobility of the former. Crystals are statical, whilst organisms are dynamical aggregates, though the evolutions of both marked by their peculiar characteristics, may be regarded as visible expressions testifying to the existence of one all-pervading power—

“Whose dwelling is the light of setting suns,  
And the round ocean, and the living air,  
And the blue sky, and in the mind of man :  
A motion and a spirit that impels  
All thinking things, all objects of all thought,  
And rolls through all things.”

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## NATURAL HISTORY MISCELLANY.

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### BOTANY.

ON THE LEVER-LIKE ANTHERS IN *SALVIA*.—It must, I think, be evident to many observers that what we are prone to consider beautiful adaptations in the organs of flowers, are, as we should say of many of the operations of men, merely *afterthoughts*; that is to say that often parts would be formed without any idea of the uses which would be subsequently made of them. I have perceived this for some time, but hardly dared express it in the face of the universal belief that everything was designed for some special use and purpose. Last year, however, I submitted in these pages the